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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/670,413	09/24/2003	Hyunchul C. Kim	130588.91477	7926

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EXAMINER

ANDUJAR, LEONARDO

ART UNIT PAPER NUMBER

2826

DATE MAILED: 06/08/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No. 10/670,413	Applicant(s) KIM ET AL.	
	Examiner Leonardo Andújar	Art Unit 2826	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 15 April 2005.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-22 is/are pending in the application.
- 4a) Of the above claim(s) 15-22 is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1,3-8 and 10-14 is/are rejected.
- 7) ☒ Claim(s) 2 and 9 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|--|---|
| 1) <input checked="" type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____ |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| 3) <input checked="" type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date <u>03/05</u> | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of group I (claims 1-14) in the reply filed on 04/15/2005 is acknowledged.

Claim Rejections - 35 USC § 103

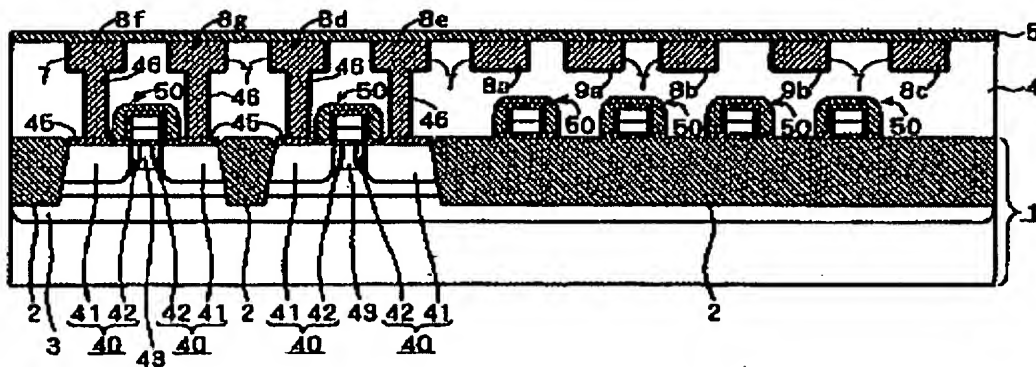
2. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

3. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).
4. Claims 1, 3-6, 8 and 10-14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kunikiyo (US 6,717,267 see remarks) in view of Summerfelt et al. (US 6,773,930).
5. Regarding claims 1, 8, 10 Kunikiyo shows most aspects of the instant invention including a semiconductor device, comprising: a substrate 1; first and second active

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regions 40 of first and second transistors disposed above the substrate; a copper interconnect 8/5 coupled between the first active region and the second active region of the first and second transistors; and a barrier layer 7 disposed under the copper interconnect, wherein the barrier layer comprises titanium and nitride (col. 11/24-35).

FIG. 1

Kunikiyo does not disclose that the barrier layer may comprise aluminum and oxygen. Nevertheless, Summerfelt discloses that TiAlON is a suitable material for a barrier layer (abstract). It would have been obvious to one having ordinary skill in the art at the time the invention was made to use TiAlON as a barrier material in the device disclosed by Kunikiyo as suggested by Summerfelt since it has been held to be within the general skill of a worker in the art to select a known material on the basis of its suitability for the intended use as a matter of obvious design choice. In re Leshin, 125 USPQ 416.

6. Regarding claims 3 and 11, Kunikiyo teaches that the substrate is made of silicon (col. 1/ll. 67).
7. Regarding claims 4 and 12, although Kunikiyo in view of Summerfelt does not explicitly teach that TiAlON that the barrier layer limits the migration of copper. This is an inherent property of the TiAlON.
8. Regarding claims 5 and 13, Kunikiyo teaches a silicide region 45 formed in the first and second active regions and making electrical contact with the copper interconnect, wherein a portion the barrier layer resides between the copper interconnect and the silicide region (see fig. 30).
9. Regarding claims 6 and 14, Kunikiyo shows an oxide layer 4 disposed between the copper interconnect and the substrate, wherein a portion of the barrier layer resides between the copper interconnect and the substrate (col. 4/ll. 62).
10. Claim 7 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kunikiyo (US 6,717,267) in view of Summerfelt et al. (US 6,773,930) further in view of Lopatin et al. (US 6,368,961).
11. Regarding claim 7, Kunikiyo in view of Summerfelt shows most aspects of the instant invention except for adhesion layer disposed between the copper interconnect and the oxide layer 4. Nevertheless, Lopatin teaches that a thin adhesion layer formed of an adhesion material, such as the unnitrided form of the barrier material, is often first deposited on the dielectrics or vias to ensure good adhesion and good electrical contact of the subsequently deposited seed layers to underlying doped regions and/or conductive channels (col. 2/lls. 19-31). It would have been obvious to one having

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ordinary skill in the art at the time the invention was made to use an adhesion barrier between the copper interconnect and the oxide layer disclosed by Kunikiyo in view of Summerfelt to ensure good adhesion and good electrical contact of the subsequently deposited seed layers to underlying doped regions and/or conductive channels as taught by Lopatin.

Allowable Subject Matter

12. Claims 2 and 9 are objected to as being dependent upon a rejected base claim, but would be allowable if rewritten in independent form including all of the limitations of the base claim and any intervening claims.

Remarks

13. If a copy of a provisional application listed on the bottom portion of the accompanying Notice of References Cited (PTO-892) form is not included with this Office action and the PTO-892 has been annotated to indicate that the copy was not readily available, it is because the copy could not be readily obtained when the Office action was mailed. Should applicant desire a copy of such a provisional application, applicant should promptly request the copy from the Office of Public Records (OPR) in accordance with 37 CFR 1.14 (a)(1)(iv), paying the required fee under 37 CFR 1.19(b)(1). If a copy is ordered from OPR, the shortened statutory period for reply to this Office action will not be reset under MPEP § 710.06 unless applicant can demonstrate a substantial delay by the Office in fulfilling the order for the copy of the provisional application. Where the applicant has been notified on the PTO-892 that a copy of the provisional application is not readily available, the provision of MPEP § 707.05(a) that a

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copy of the cited reference will be automatically furnished without charge does not apply
(See MPE 707.05(g)).

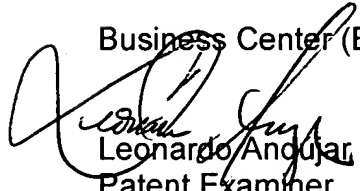
Conclusion

14. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Leonardo Andújar whose telephone number is 571-272-1912. The examiner can normally be reached on Mon through Thu from 9:00 AM to 7:30 PM EST.

15. If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Nathan J. Flynn can be reached on 571-272-1915. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

16. Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic

Business Center (EBC) at 866-217-9197 (toll-free).



Leonardo Andújar
Patent Examiner
Art Unit 2826
05/18/2005